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ARMILLARIA (TRICHOLOMATACEAE, AGARICALES)  
IN THE WESTERN UNITED STATES INCLUDING  
A NEW SPECIES FROM CALIFORNIA

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*Armillaria* Kummer has, to a large extent, been neglected by agaricologists, and no extensive treatment of North American species has appeared since that of Kauffman (1922). Prior to his publication, the only available treatment of the genus was that of Murrill (1914). Both of these works are difficult to use because many species that no longer belong in *Armillaria* are included. The common occurrence of a new species, described below, as well as the frustration resulting from the inability to identify numerous collections belonging to this genus, stimulated us to devote some time to the taxonomy of the species that occur in California, and, to a lesser extent, to those occurring in western United States. Results of this investigation along with a key to western North American *Armillarias* are presented below. Colors in quotations are from Ridgway (1912).

*Armillaria*, as conceived by us, includes those white-spored mushrooms that have attached rather than free lamellae, a centrally attached stipe, and a partial veil that usually forms an annulus. Based on their frequency of appearance, two groups of *Armillaria* species can be recognized in the United States west of the Rocky Mountains. One group, which includes *A. mellea*, *A. ponderosa*, *A. zelleri*, *A. albolanaripes*, and *A. olida*, fruits every year and usually in considerable abundance. The second group contains species that appear only sporadically and are rare, particularly in California. Included in this group are *A. caligata*, *A. subcaligata*, *A. robusta*, *A. luteovirens*, and *A. viscidipes*.

## Key to the Armillarias of Western United States

- a. Lamellae decurrent or nearly so; basidiocarps lignicolous or growing in the close vicinity of wood, often cespitose.....1. *A. mellea*
- a. Lamellae adnate or adnexed; basidiocarps usually not lignicolous or cespitose .....b.
- b. Pileus yellow at least when young, some may darken with age.....c.
- b. Pileus white, orange, or reddish, sometimes colored otherwise but not yellow .....d.
- c. Pileus noticeably scaly at least on the margin, stipe with similar scales; basidiocarps not darkening to brown or vinaceous with age .....2. *A. luteovirens*
- c. Pileus glabrous or appressed fibrillose when young, usually noticeably appressed fibrillose when old; pileus surface darkening to brown, vinaceous, or olive with age.....3. *A. albolanaripes*
- d. Pileus distinctly viscid or subviscid when wet (viscosity may be apparent only when young).....e.
- d. Pileus moist or dry, but not distinctly viscid.....f.
- e. Pileus orange to orange-red, with olive stains; stipe with similarly colored scales; odor strongly farinaceous.....4. *A. zelleri*
- e. Pileus pallid to whitish or pale buff; lacking orange-colored stains or scales; odor strongly subalkaline.....5. *A. viscidipes*
- f. Pileus brown to grayish brown or pale olive, stipe white, glabrous to to silky fibrillose; annulus fibrillose, sometimes disappearing; odor strong, unpleasant, of rotting white potatoes; subalpine in distribution.....6. *A. olida*
- f. Basidiocarps not with the above characters.....g.
- g. Pileus white or whitish, usually with buff or rust-colored stains or spots; stipe with strongly developed, sheathing veil; odor spicy, aromatic .....7. *A. ponderosa*
- g. Basidiocarps not as above; pileus usually darker colored (brown to reddish brown).....h.
- h. Pileus reddish to reddish brown; lamellae pallid, with reddish spots.....8. *A. robusta*
- h. Basidiocarps not as above; pileus brown to dark brown.....i.
- i. Spores 6.0–7.5 by 5  $\mu\text{m}$ .....9. *A. caligata*
- i. Spores 9.6–12.0 by 7.8–9.6  $\mu\text{m}$ .....10. *A. subcaligata*

## 1. ARMILLARIA MELLEA (Vahl ex Fr.) Kummer

This species, which is abundant throughout most of North America, is characterized by decurrent to subdecurrent lamellae, brown, fibrillose scaly pilei, typically lignicolous habitats, and often large clusters of basidiocarps. Its macroscopic characters are highly variable and it is sometimes difficult to identify. At times it is parasitic and attacks the roots of a wide range of hardwood trees and shrubs causing considerable damage. Often, however, it is saprophytic on both hardwoods and conifers.

*Armillaria mellea* and *Clitocybe tabescens* (Scop. ex Fr.) Bres. and some less common species of both genera have been placed in *Armillariella* by many (Singer, 1975). This segregation is based largely upon the lack of amyloid spores and occurrence of a bilateral type of lamellar trama in these taxa. The characters are supplemented, at least in some species, by the development of conspicuous black rhizomorphs and by the lignicolous habitat. Segregation may be the proper disposition of these taxa; however, because the amyloidity of the spore wall is weak or absent in other *Armillarias* and because the bilateral nature of the lamellar trama is usually apparent only in very young basidiocarps and often easily overlooked even then, we prefer to keep these species in *Armillaria* for the present.

2. *ARMILLARIA LUTEOVIRENS* (A. & S. ex Fr.) Gill.

Not yet known from California, this *Armillaria* is rare to infrequent throughout western North America, and we have seen fresh material only from Utah. Smith (1975) published an excellent photograph made from specimens collected in Oregon. This taxon is most likely to be confused with *A. albolanaripes*. A white form, *A. luteovirens* f. *alba* A. H. Smith, occasionally occurs along with the more typical yellow specimens (Smith and Walters, 1947).

3. *ARMILLARIA ALBOLANARIPES* Peck

This agaric is common in both the coastal and alpine regions of California as well as throughout most of the western United States. It is easily recognized by the rather large, soft, white, cottony scales on the surface of that part of the stipe below the annulus and the yellow pileus, which develops olive or brownish to vinaceous colors when old or dried. Furthermore, the cuticle frequently forms rather large, fibrillose scales, which are often rather conspicuous with age. It may be confused with *A. luteovirens* (q.v.) or *A. zelleri* (q.v.).

4. *ARMILLARIA ZELLERI* Stuntz & A. H. Smith

*Armillaria zelleri* appears to be confined to the western United States, occurring from Washington to California along the coast and inland as far as Arizona. It is distinguished by the viscid to glutinous pileus, which is orange to orange-red, often developing olivaceous stains or spots with age, the orange to orange-red scales on the stipe, and the strong farinaeous odor. It is distinguished from the somewhat similarly colored *A. robusta* by the viscid pileus and stipe. *Armillaria zelleri* is also quite similar in appearance to some species of *Tricholoma* such as *T. awran-tium* (Schaeff. ex Fr.) Ricken and *T. subannulatum* Batsch & Bres.; however, unlike these species, it has an annulus and adnate to adnexed lamellae.

5. *ARMILLARIA VISCIDIPES* Peck

This species of *Armillaria* is not yet known from California and apparently has been recorded from western North America only by Kauffman (1925; Hotson, 1940) who found it in the vicinity of Mount Hood in northern Oregon. The only other known locality is New England. This

species has a very thin but distinct viscid layer on the pileus and a similar layer on that part of the stipe covered by the universal veil. In addition, it was characterized by Kauffman as having a "strong subalkaline odor". Herbarium material of this species from the eastern United States possesses the viscid layers and is rather reminiscent of *A. ponderosa* in color and stature. It is possible some collections of *A. viscidipes* have been misdetermined as *A. ponderosa*.

6. *Armillaria olida* Thiers & Sundberg, sp. nov.

Pileus 7–15 cm latus, e convexo planus, siccus vel udus, glaber vel subtomentosus, albus demum bubalinus vel brunneus, saepe olivaceo-tinctus. Contextus 0.5–1.5 cm crassus, albus. Sapor farinaceus, odor ingratus. Lamellae albae, adnatae vel adnexae. Stipes 8–14 cm longus, 2.0–3.5 cm crassus, aequalis vel subclavatus, albus, super anulum glaber vel sericeo-fibrillosus, infra anulum fibrillosus vel fibrilloso-squamosus. Annulus albus, fibrillosus. Sporae 10.5–12.5  $\mu\text{m}$  longae; 5.0–6.7  $\mu\text{m}$  crassae, ellipsoideae. Cystidia nulla. Cuticula pilei ex hyphis intertextis composita. Basidiocarpium gregarium in humo sub arboribus coniferis.

Holotypus: California, El Dorado Co., Crystal Basin Recreation Area, 6 May 1972, *H. D. Thiers 28816* (SFSU).

Pileus 7–15 cm broad at maturity, convex to broadly convex when young, typically becoming plane to shallowly depressed with age, often with the margin becoming elevated and highly irregular in outline; surface dry to moist but not viscid, dull, glabrous to somewhat tomentose, usually appearing streaked or appressed fibrillose when old, and usually with a thin, white, filamentous layer on the disc, at least when young; when very young, or when covered with litter, surface white or whitish, with age and upon exposure to light becoming fuscous to brown ("mikado brown" to "buckthorn brown"), sometimes much paler ("clay color" to "warm buff"), and frequently with olive or grayish shades; not changing color when bruised; margin incurved when young, becoming decurved at maturity, entire.

Context 0.5–1.5 cm thick, white, unchanging or darkening slightly when exposed. Taste farinaceous. Odor very strong, unpleasant, and strongly reminiscent of rotting white potatoes.

Lamellae adnate to adnexed when young, seceding and often appearing free or deeply notched with age; white when young, usually assuming a pinkish cast with age; close to subdistant, broad, thick, margin entire, concolorous; 2–3 tiers of lamellulae.

Stipe 8–14 cm long, 2.0–3.5 cm broad at the apex; equal to somewhat enlarged at the base or subclavate; surface white to pale buff ("pale olive buff") during all stages, unchanging when bruised; glabrous to silky appressed fibrillose above the annulus, appressed fibrillose to fibrillose scaly below; dry; solid, context white, unchanging when exposed. Annulus median to superior, fibrillose and sometimes poorly developed but always present, white but staining brown or orange when bruised.

Spores white in deposit, 10.5–12.5 by 5.0–6.7  $\mu\text{m}$ , ellipsoid, apiculus eccentric, walls thin, smooth, hyaline in KOH, inamyloid (pale yellow). Basidia 4-spored, clavate, hyaline in KOH, 23–30 by 8–10  $\mu\text{m}$ , siderophilous granules (red-staining granules when mounted in acetocarmine) absent; no cystidia present; lamellar trama parallel to obscurely interwoven, hyaline, hyphae 2–4  $\mu\text{m}$  in diam.; pileus trama homogeneous, interwoven, hyphae 3–5  $\mu\text{m}$  in diam.; cuticle differentiated as a layer of interwoven, gelatinous hyphae (an ixotrichodermium), 200–300  $\mu\text{m}$  broad, hyaline in KOH, hyphae 2–4  $\mu\text{m}$  in diam. No caulocystidia seen. Clamp connections absent.

Habit, habitat, and distribution: Solitary to gregarious and often buried in humus under conifers (*Abies* and *Pinus*) at elevations of 1200 m and above throughout the Sierra Nevada and less commonly in the coastal ranges in central and northern California.

Material studied: Calaveras Co.: *Thiers* 16756. El Dorado Co.: *Thiers* 28818 (Holotype), 30911, 32229, 34050; *Sundberg* 1875, 1936. Fresno Co.: *Thiers* 34218. Mendocino Co.: *Toren* 1266. Nevada Co.: *Thiers* 32199. Sierra Co.: *Thiers* 25360, 28938. Siskiyou Co.: *Thiers* 25407. Tuolumne Co.: *Thiers* 19488, 25321, 30915. All in SFSU.

Discussion: The inamyloid spores of *A. olida* places it in sect. *Ponderosa*, but its relationship with other species remains unclear. Also, the stature and color of the pileus are somewhat suggestive of species in *Lyophyllum* sect. *Constricta*; however, there are no siderophilous granules in the basidia.

#### 7. ARMILLARIA PONDEROSA (Peck) Sacc.

This large, sturdy mushroom occurs throughout the western states at all elevations and often in considerable abundance. It is eagerly sought as an esculent and is sometimes exported to other countries. In addition to the robust nature of the basidiocarp, it is characterized by the white or whitish pileus, which often has brown or rust-colored stains, a sheathing, well developed annulus, a spicy, aromatic odor, and globose to subglobose spores. *Armillaria caligata* and *A. subcaligata* A. H. Smith & Rea, with which it might possibly be confused because of the similarity of odors, are distinguished by the much darker colored pilei, while *A. viscidipes*, which has a somewhat similarly colored pileus, is viscid. *Armillaria arenicola* Murr. and *A. magnivelaris* (Peck) Murr., both reported from the west coast, are apparently synonyms of *A. ponderosa*, but material of these species has not been seen by us.

#### 8. ARMILLARIA ROBUSTA Fr.

This species is not known from California. The only record of its occurrence on the west coast of the United States is a somewhat tentative identification made by A. H. Smith of a collection from Olympic National Park in Washington. It has been found by one of us (HDT) in the coniferous forests of northern Arizona. *Armillaria robusta* is very similar in color and general appearance to *A. zelleri*, and the two species are likely to be confused as evidenced by Zeller's (1938) report

of its presence in Oregon, which, according to Smith (1949), was based upon a collection of *A. zelleri*. The only major macroscopic difference between the two species is the absence of a viscid layer on either the pileus or stipe of *A. robusta*.

#### 9. ARMILLARIA CALIGATA Fr.

This *Armillaria* has not been reported from California but probably occurs here. At present it is known with certainty only from the Puget Sound area, Washington (McKenny and Stuntz, 1971). *Armillaria caligata* has an odor like that of *A. ponderosa* and is somewhat similar to it macroscopically. The pileus surface of *A. caligata*, however, has rather large, dark-colored, appressed fibrillose scales and the basidiocarps are smaller and more delicate. *Armillaria subcaligata*, which does occur in California, is similar to *A. caligata* except that it has larger spores and bilateral lamellar trama (Smith and Rea, 1944).

#### 10. ARMILLARIA SUBCALIGATA A. H. Smith & Rea

Fresh material of this species has not been seen by either of us. It is apparently very rare, and, to the best of our knowledge, is known only from the type locality in the Santa Barbara region of California where it was collected in a "dry lawn" (Smith and Rea, 1944). For additional comments see the discussion under *A. caligata*.

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